EMBRYOLOGY

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EMBRYOLOGY

- ✓ The science dealing with the *formation, development, structure, and functional* activities of embryos (Dict.).
- ✓ The science deals with the processes and regulations in the *prenatal growth* and development of an organism/individual in the female genital tract.
- ✓ It begins with the fusion of male and female gametes i.e., *Fertilization* in the fallopian tube up to the *birth as a neonate*.

SUBDIVISIONS OF EMBRYOLOGY

- ✓ *General embryology:* It is the study of development of first 8 weeks after fertilization. During this period, the single-celled zygote is converted by cell multiplication, migration and reorganization into a miniature form of an individual with various organs and organ systems of the body.

- ✓ *Systemic embryology:* Study of embryological development of individual systems of the body i.e., development of cardiovascular system, digestive system, urinary system, genital system, etc.

- ✓ *Comparative embryology:* Comparative study of embryos in different species of animals.

- ✓ *Experimental embryology:* Experimental study in development embryos such as, for understanding the effects of certain drugs, environmental changes that are induced (exposure to radiation, stress) on the growth and development of embryos and fetuses of lower animals.

- ✓ *Biochemical and molecular aspects in embryology:* Chromosomes, gene sequencing, regulation.

- ✓ *Teratology*: Branch of embryology that deals with abnormal embryonic and fetal development, i.e. congenital abnormalities or birth defects.

DEVELOPMENT OF A HUMAN BEING

- ✓ Development before birth is called ***prenatal development***, and that after birth is called ***postnatal development***.

- ✓ Each period is further subdivided into several stages.

Prenatal Development

1. Preimplantation/pre-embryonic period
2. Embryonic period
3. Fetal period

Postnatal Period of Development

1. Neonatal period
2. Infancy
3. Childhood
4. Puberty
5. Adolescence
6. Adulthood
7. Middle age
8. Old age

PRENATAL DEVELOPMENT

Preimplantation/Pre-embryonic Period

- ✓ It extends from fusion of male and female gametes to form single-celled zygote to formation of primitive germ layers of developing organism.
- ✓ It includes 1st and 2nd weeks of intrauterine development.

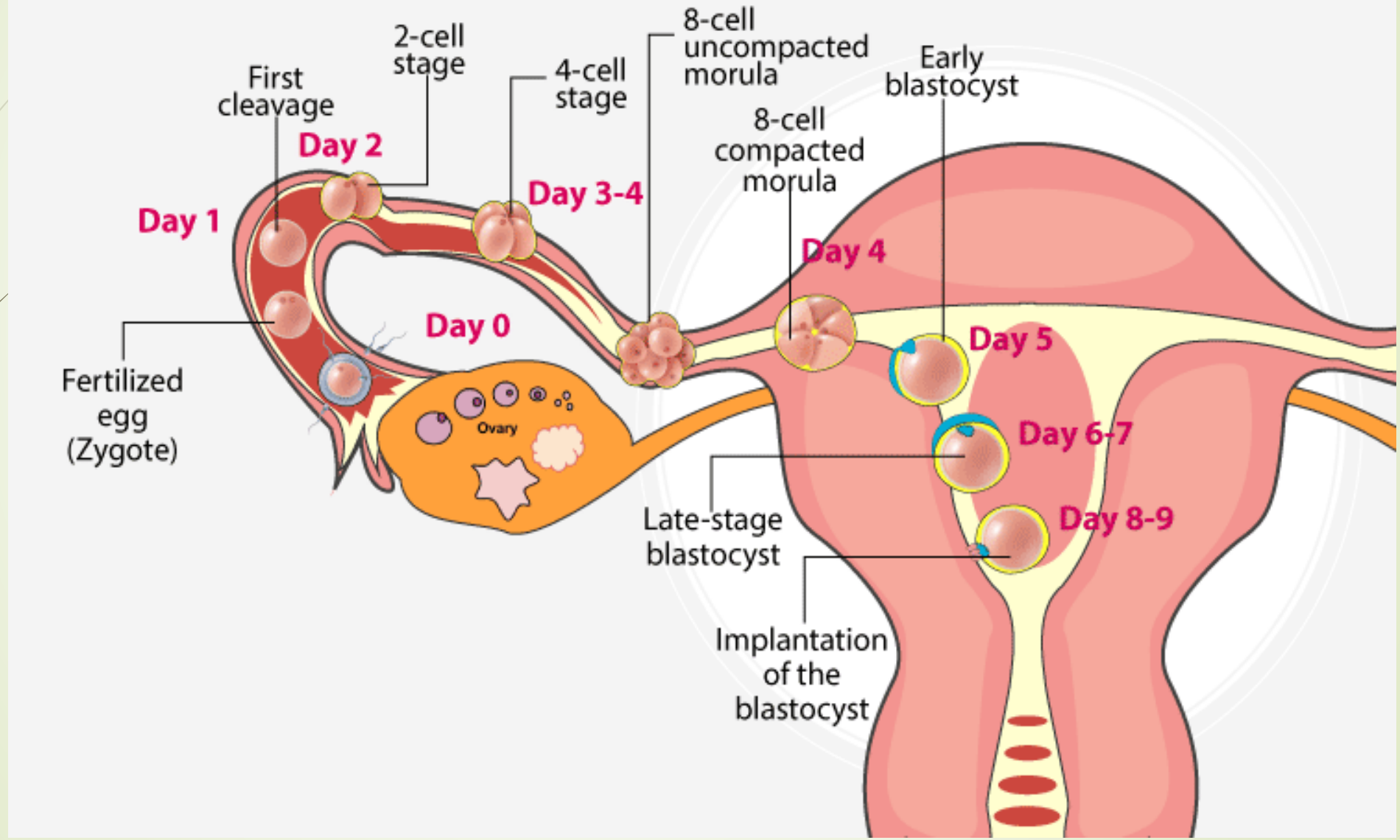
Events occur during this period

1. *Fertilization*: Fusion of male and female gametes resulting in the formation of zygote.

2. *Cleavage*: A series of mitotic divisions of zygote resulting in the formation of morula.

3. *Transportation of cleaving zygote*, i.e. morula along the fallopian tube toward the uterus.

FERTILIZATION AND IMPLANTATION



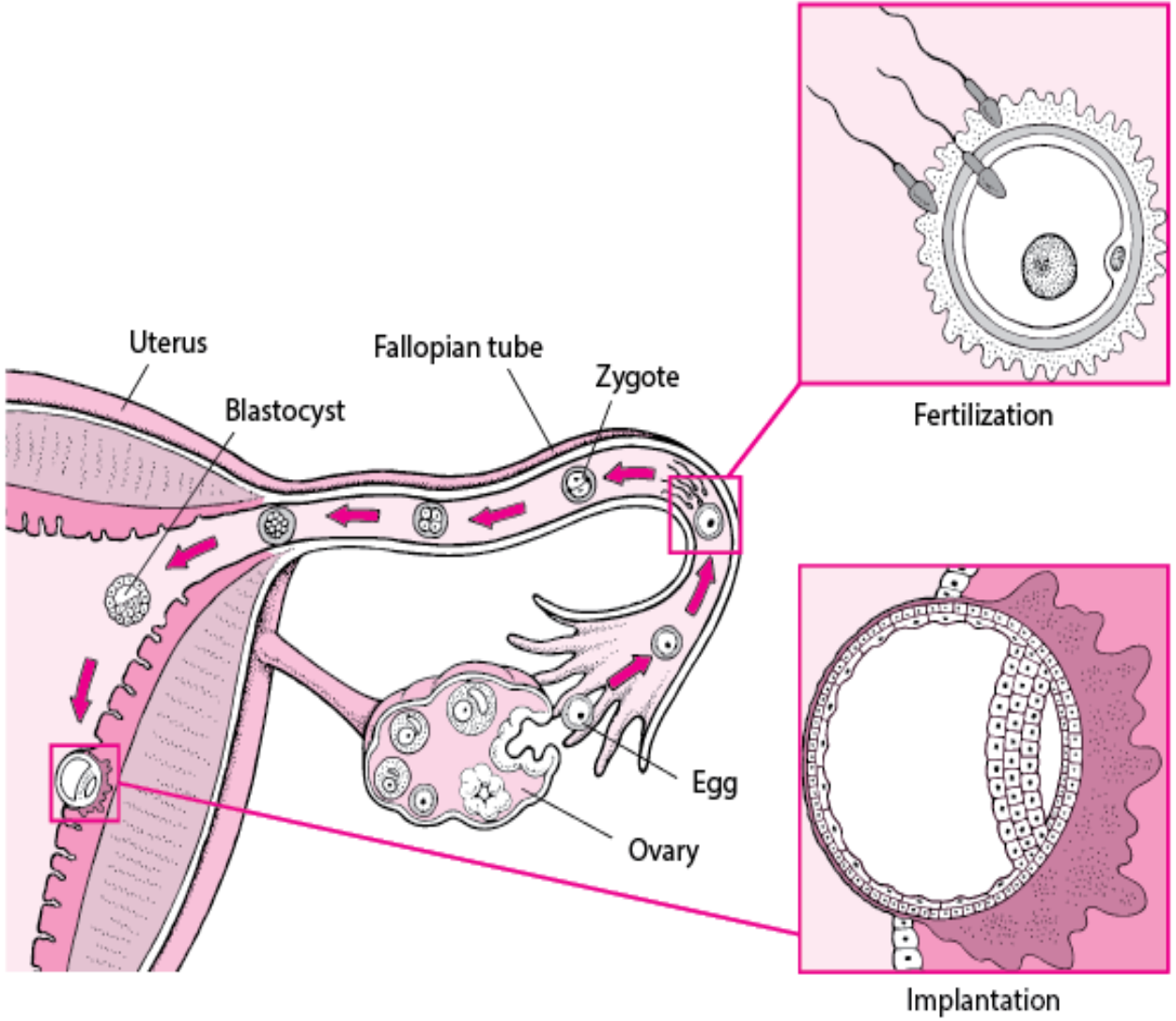
4. *Blastocyst*: Structural and functional specialization and reorganization of cells (blastomeres) of cleaving zygote that becomes blastocyst.

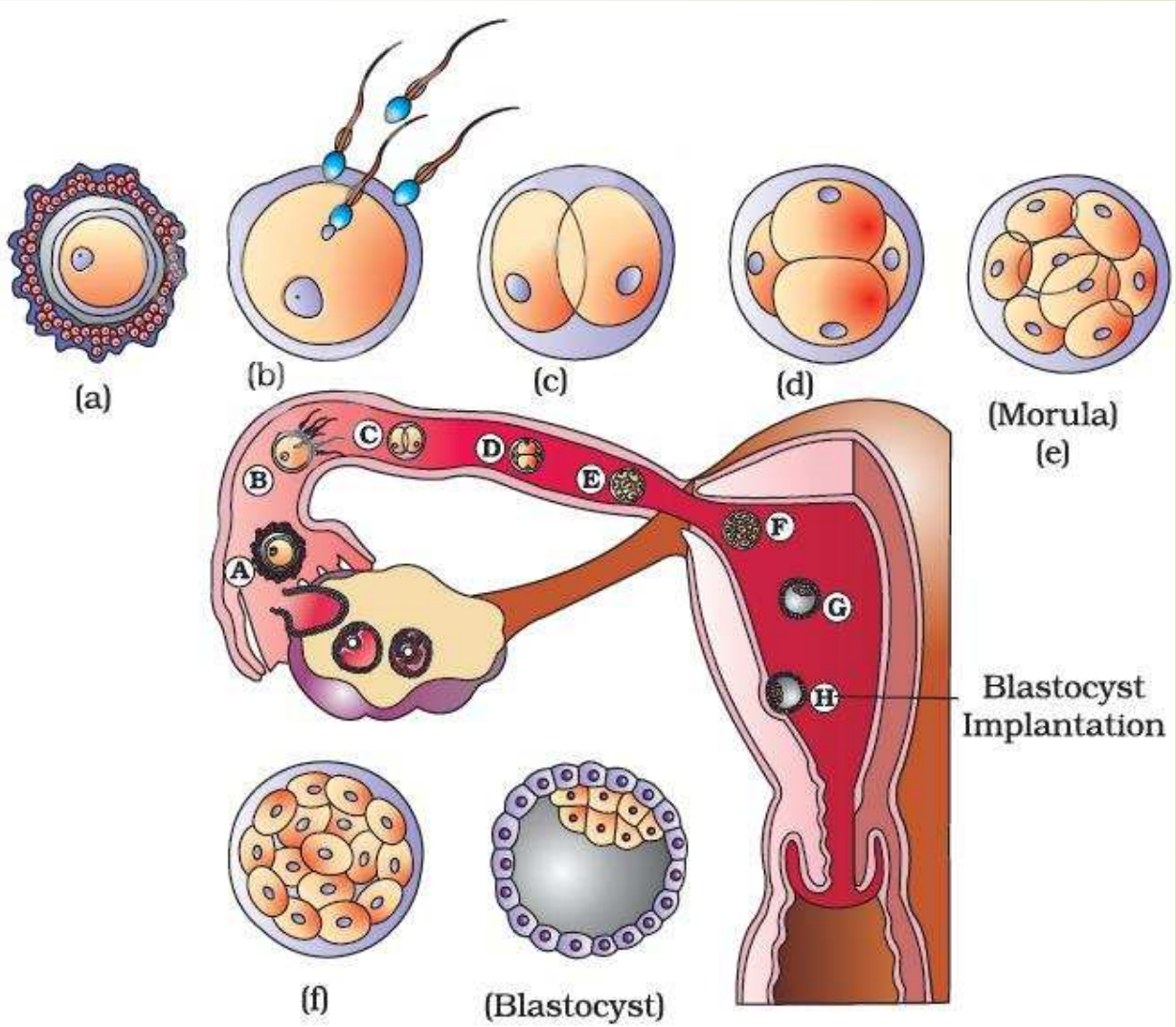
5. *Implantation*: Process of attachment of blastocyst to the uterine endometrium is called implantation.

6. *Specialization of primordial embryonic tissue*: It involves specialization of blastomeres to form embryonic structures *(embryoblast)* and supportive/nutritive structures *(trophoblast)*.

7. *Differentiation of embryoblast* -to form the primitive two layered *(bilaminar)* germ disc having ectoderm and endoderm.

8. Differentiation of trophoblast into *cytotrophoblast* and *syncytiotrophoblast*.


Uterus
Fallopian tube
Zygote
Blastocyst
Egg
Ovary
Fertilization
Implantation


(a)
(b)
(c)
(d)
(Morula)
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A
B
C
D
E
F
G
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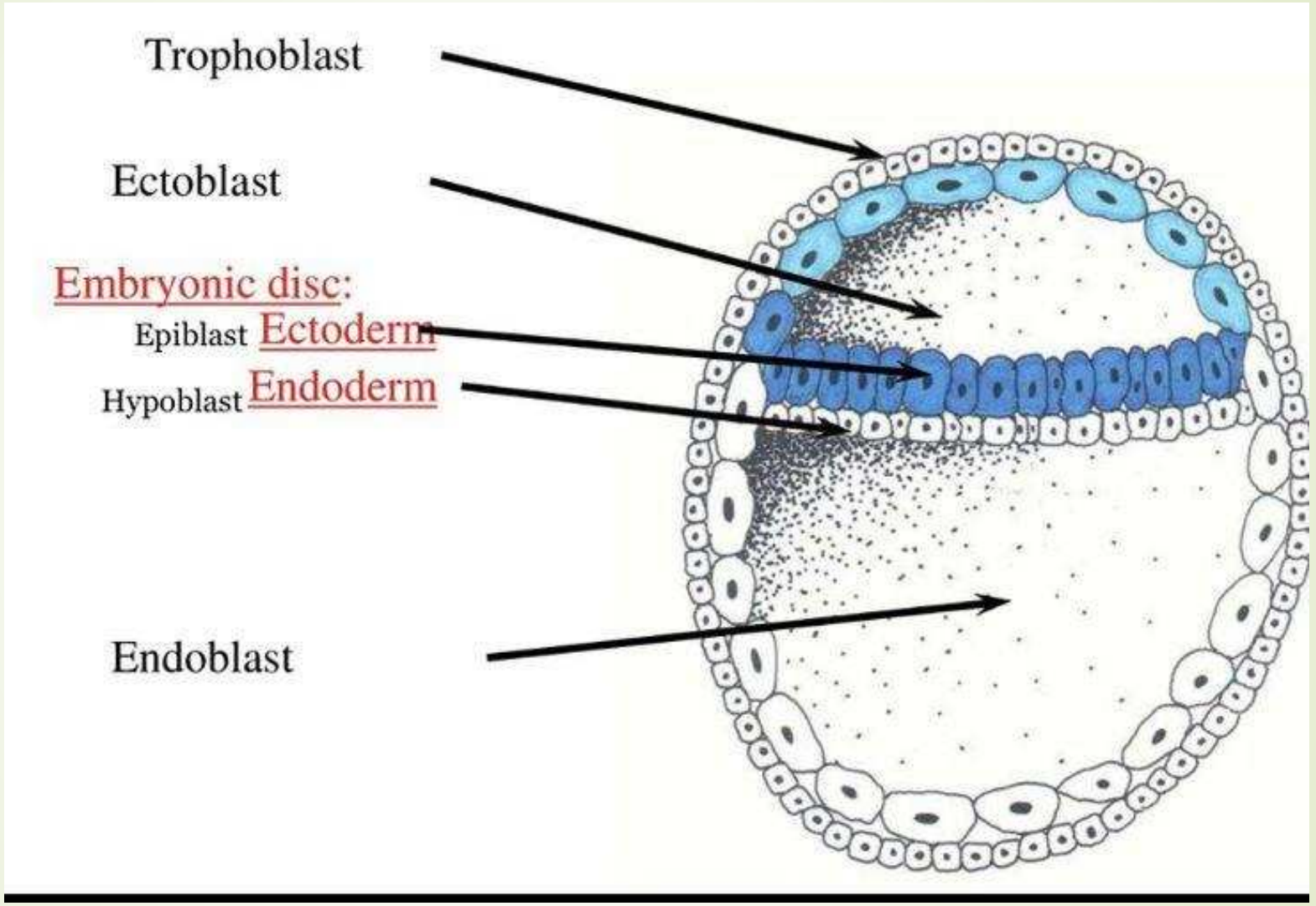
Blastocyst
Implantation
(f)
(Blastocyst)


Trophoblast
Ectoblast
Embryonic disc:
Epiblast Ectoderm
Hypoblast Endoderm
Endoblast

Embryonic Period

✓ It extends from 3rd week of intrauterine life to 8th week of intrauterine life.

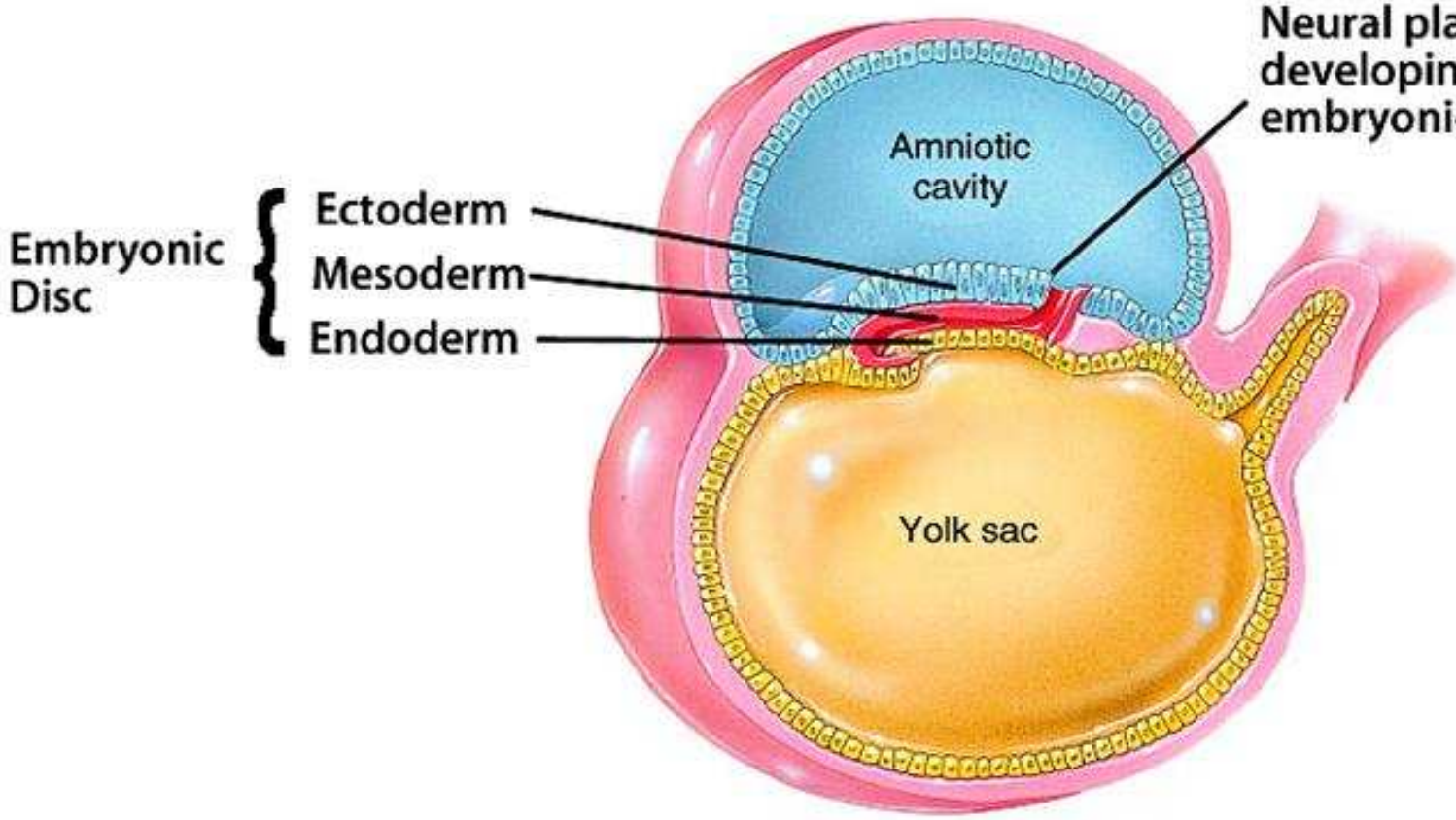
Events occur during this period

1. *Trilaminar germ disc differentiation*: Formation of three layered germ disc with the appearance of mesoderm in between ectoderm and endoderm.

2. *Early organogenesis*: Formation of primordia of various organs like lungs, heart, liver, etc.

3. *Formation of extraembryonic supportive organs and membranes*: Placenta, umbilical cord, amnion, allantois.

Trilaminar Germ Disc



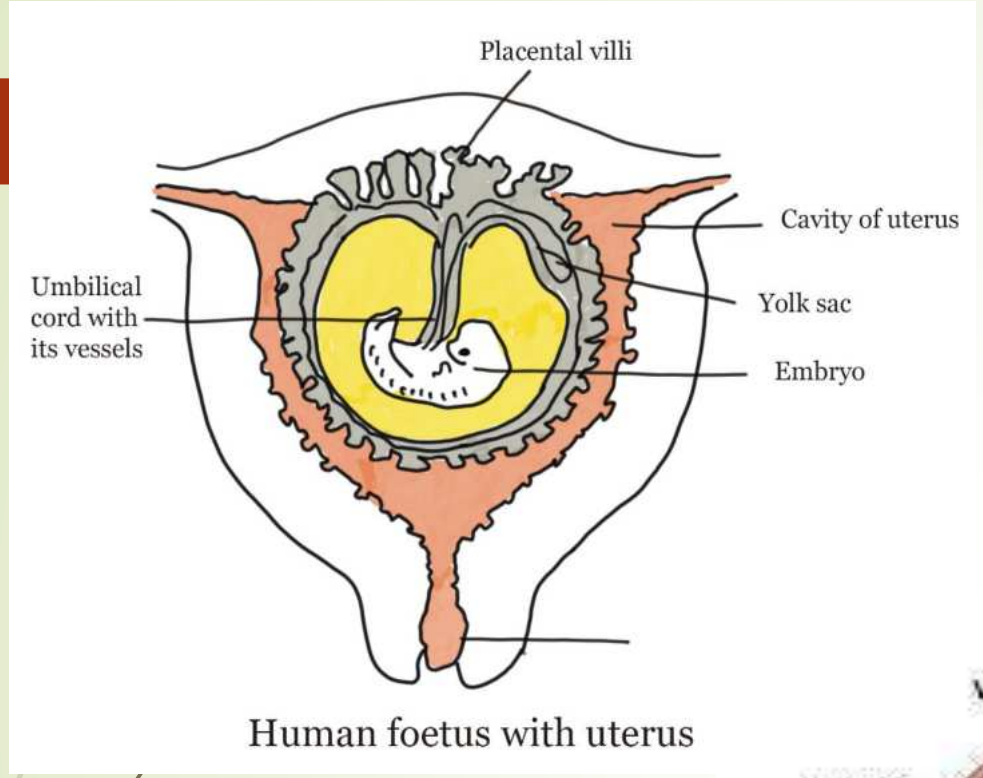
Sagittal section of trilaminar embryonic disc,
about 16 days after fertilization

Fetal Period

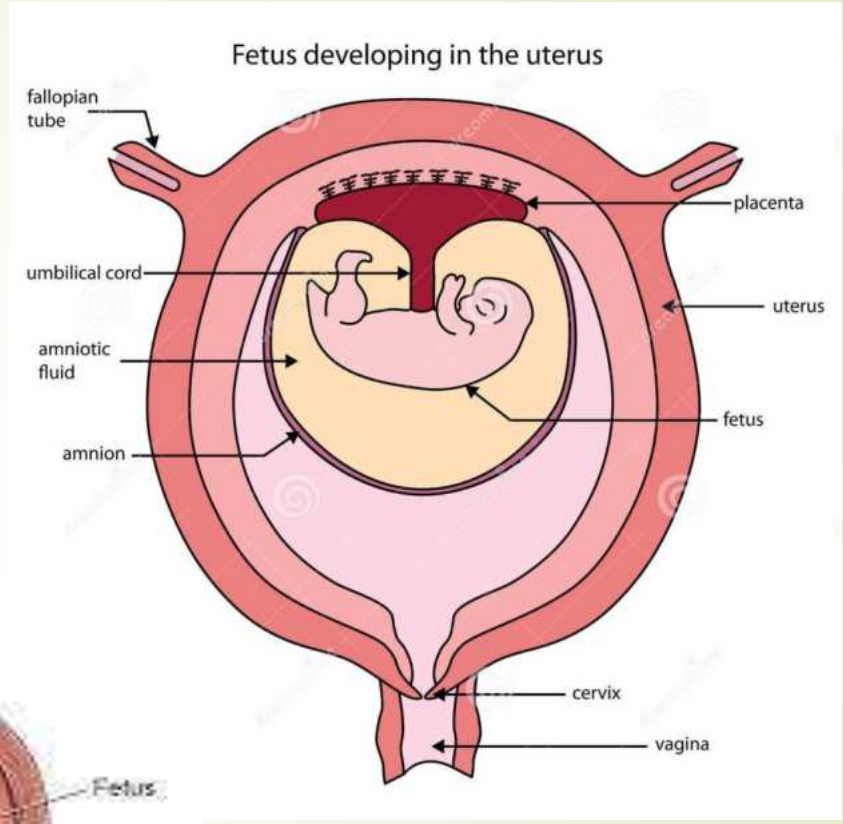
- ✓ It extends from 9th week to 9th month.

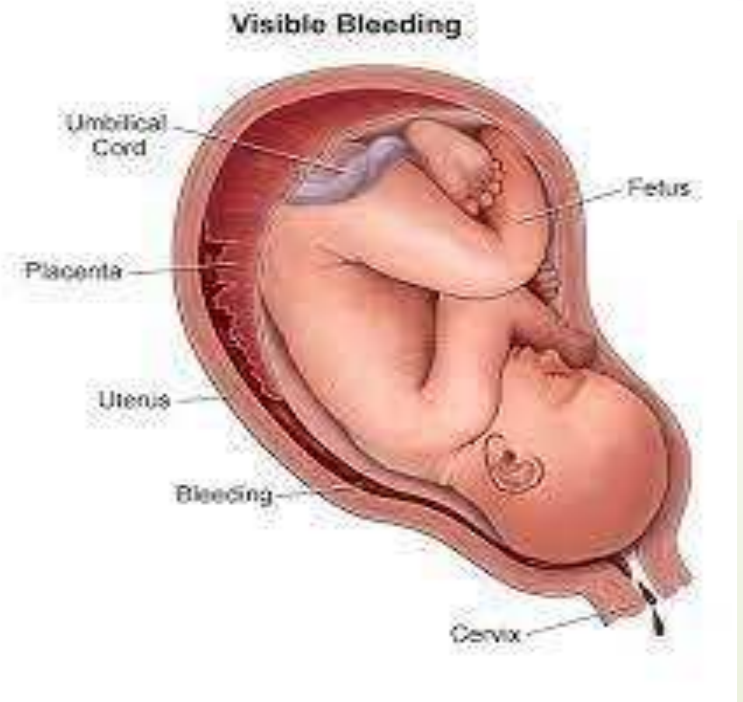
Events occur during this period

1. Growth of fetus in all dimensions
2. Specialization of various body structures.



Human foetus with uterus





POSTNATAL PERIOD OF DEVELOPMENT

- ✓ It extends from birth of an individual to adulthood.

Events occur during this period

1. *Neonatal period*: It extends from birth to 28 days after birth. These first 4 weeks are critical in the life of the newborn/neonate as various systems especially respiratory and cardiovascular have to make adjustments with the external/extrauterine environment.

NEONATOLOGY: The branch of medicine that takes care of neonates is called *neonatology*.

PERINATOLOGY: It is the branch of medicine that takes care of the fetus and newborn from 28th week of intrauterine life to 6th day of extrauterine life.

2. *Infancy*: It extends from 1 month to 1 year and the newborn during this period is called *infant*.

3. *Childhood*: It extends from 2nd year to 12th year of age and an individual is called a child. It is the period of rapid growth and development. This age is also called *pediatric age*.

PEDIATRICS AND PEDIATRICIAN: The medical branch that deals with infants and children is called *pediatrics*. The specialist who treats them is known as *pediatrician.*

4. *Puberty*: It extends from 12 years to 16 years. There will be rapid physical growth and development of secondary sex characters and it depends on the interaction of sex hormones and growth hormones.

5. *Adolescence*: It extends from 17 years to 20 years. During this period, there will be rapid physical growth and sexual maturation. The reproductive ability is established.

6. *Adulthood*: It extends from 21 years to 40 years.

7. *Middle age*: It extends from 40 years to 60 years.

8. *Old age*: It extends from more than 60 years to death.

ONTOGENY: Complete life cycle of an organism involving both prenatal and postnatal developments is called ontogeny.

PHYLOGENY: Evolutionary/ancestral history of a group of organisms is called phylogeny.

IMPORTANCE OF EMBRYOLOGY IN THE MEDICAL PROFESSION

- ✓ *Normal development: How from a single cell develops into a new born containing numerous tissue and organs.*
- ✓ *Developmental abnormalities:* Embryology helps us understand why some children are born with organs that are abnormal.
- ✓ *Understanding postnatal and adulthood diseases:* absence of an ear or presence of an extra finger to hypertension, diabetes, depression, cardiovascular and renal diseases.
- ✓ *Health care strategies for better reproductive outcome:* performing surgeries for correction of a defect in the diaphragm prenatally; postnatal correction of a cardiac defect etc.